

Course Evaluation

- Fill-in the bubbles.
- Extra comments are appreciated and should be included on the back.
- There is no formal evaluation of the grader, Rui Yang, but you can add comments on the back (make sure to indicate towards whom the comments are directed).

Summary of Covered Topics

Important concepts:

- Impedance
- Amplification
- Frequency/Fourier Analysis
- Feedback

Important electronics components and equipment:

- Resistors, capacitors, inductors.
- Special components: transformers, photodiodes, thermistors, and Peltier coolers.
- Diodes, BJTs, and FETs.
- Op-amps and comparators.
- Multimeters, oscilloscopes, and function generators.
- Breadboards, prototyping boards, and soldering irons.
- Circuit simulation and layout software.

Final Exam

- 3 hours long.
- It will cover all the topics covered in the class and lab.
- You can expect some variations on the quiz and design exercise materials.
- Some questions will be on practical lab knowledge.
- Some problems will involve combining knowledge from different chapters.

Physics 351: Electronics II

What to expect?

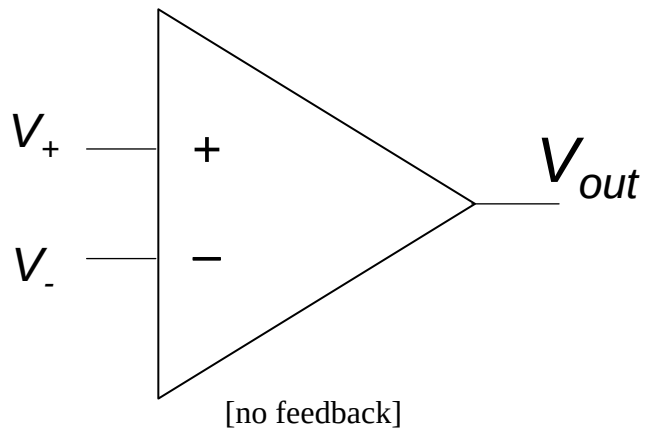
- A little bit on **NOISE** in electronics and physics.
- Mostly **DIGITAL** electronics
 - Logic gates.
 - Operations.
 - ADCs, DACs, and opto-couplers.
 - Counters, registers, and digital memory.
- A fair bit on **FPGAs**
 - C-like programming.
 - Complex digital circuits.
- USB and/or Ethernet control, input/output, data acquisition.

Comparators

Comparators are specialty op-amps designed to be used with **positive feedback** or **no feedback**.

Comparators are two-state devices which output either a **high signal** or a **low signal** depending on whether an input voltage is above or below a reference voltage.

A comparator is like an **IF** statement in computer programming.



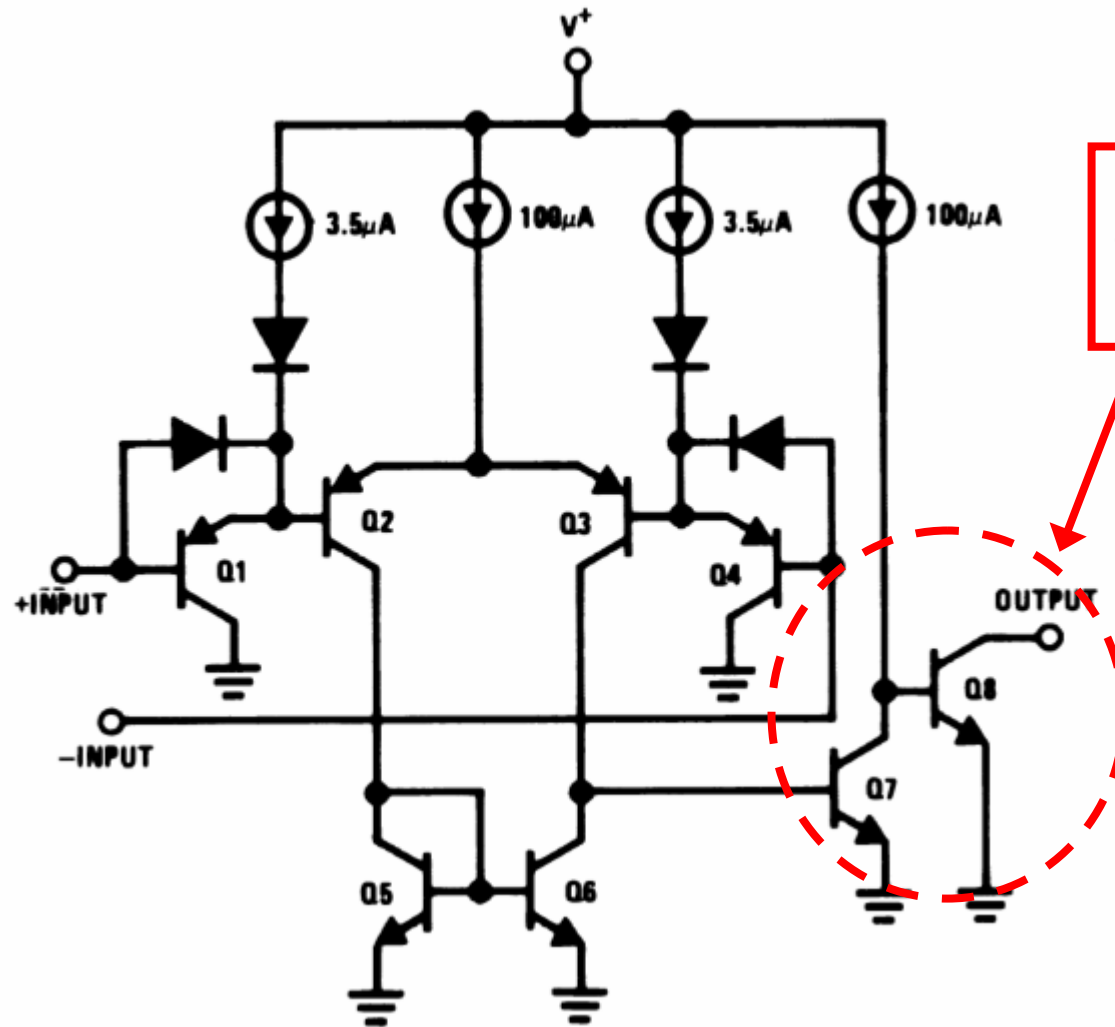
Op-amp equation: $V_{out} = Gain \times (V_+ - V_-)$

Since $Gain \sim 10^5$ - 10^6 ,

If $V_+ > V_-$, then $V_{out} = + V_{supply}$ (HIGH)

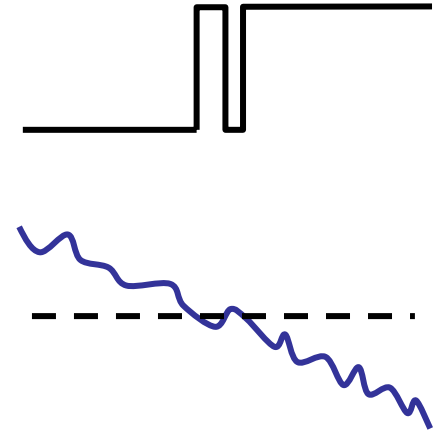
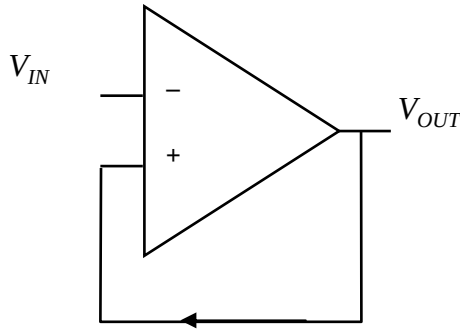
If $V_+ < V_-$, then $V_{out} = - V_{supply}$ (LOW)

The LM2903 comparator



Output is configured for use with a pull-up resistor

Positive Feedback

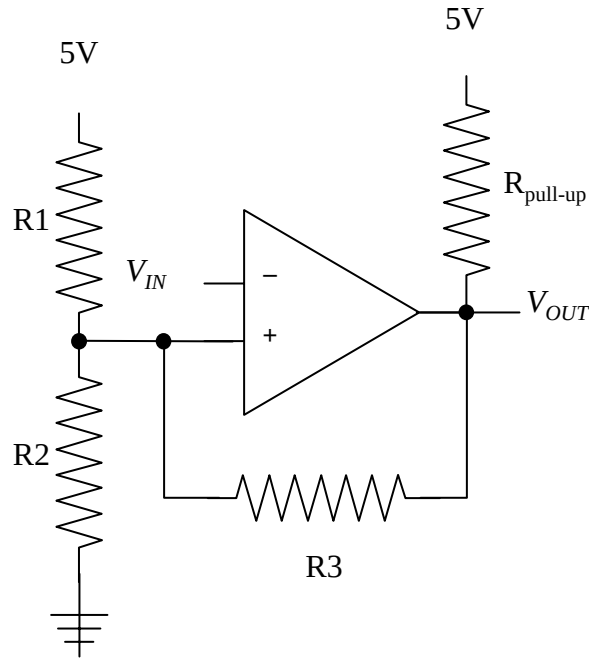


Noisy signal leads to
"false" triggering

The merits of positive feedback:

- Speed-up the choice of HIGH output or LOW output.
- Introduce **hysteresis** into comparator behavior (i.e. circuit output depends not just on the input, but on its history).

Schmitt Trigger



Hysteresis suppresses “false” triggering due to noise.

